Food Policy xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Should we stop meating like this? Reducing meat consumption through substitution

Chrysostomos Apostolidis *, Fraser McLeay

Newcastle Business School, Northumbria University, City Campus East 1, Newcastle upon Tyne NE1 8ST, UK

ARTICLE INFO

Article history:
Received 4 June 2015
Received in revised form 3 September 2016
Accepted 8 November 2016
Available online xxxx

Keywords:
Meat reduction
Meat substitutes
Choice experiment
Latent class
Market segmentation

ABSTRACT

High levels of meat consumption are increasingly being criticised for ethical, environmental, and social reasons. Plant-based meat substitutes have been identified as healthy sources of protein that, in comparison to meat, offer a number of social, environmental and health benefits and may play a role in reducing meat consumption. However, there has been a lack of research on the role they can play in the policy agenda and how specific meat substitute attributes can influence consumers to replace partially replace meat in their diets. In this paper, we examine consumers' preferences for attributes of meat and meat substitute products and develop consumer segments based on these preferences. The results of a choice experiment with 247 UK consumers, using food labels and mince (ground meat), illustrate that the type of mince, fat content, country of origin and price are major factors that influence choice. Carbon footprint, method of production and brand play a secondary role in determining consumers' choices of meat/meat substitutes. Latent class analysis is used to identify six consumer segments: *price conscious*, *healthy eaters*, *taste driven*, *green*, *organic* and *vegetarian* consumers which have different socio-demographic characteristics and meat consumption patterns. Future interventions and policies aimed at reducing meat consumption including labelling, provision of more information, financial incentives, educational campaigns and new product development will be more effective if they are holistic and target specific consumer segments, instead of focus on the average consumer.

1. Introduction

The growth of the world's population and rising disposable incomes has led to an increase in global meat consumption (de Boer et al., 2014; Hallström et al., 2014; Edjabou and Smed, 2013). However, the perceived health, social and environmental concerns associated with high levels of meat consumption have stimulated calls to reduce the quantity of meat we eat and created an on-going global debate among policy makers, practitioners and academics (Yadavalli and Jones, 2014; Hallström et al., 2014). In the UK the three part long *"Should I eat meat: the health dilemma?"* program aired at prime time on the BBC 2 national television station in 2014 and other recent news headlines including *"Can eating less meat help reduce climate change?"* (BBC, 2015) and *"Red meat linked to breast cancer"* (BBC, 2014) have increased consumer awareness on the issues related to high meat consumption. More recently the International Agency for Research on Cancer, the cancer agency of WHO, has classified the consumption of red meat (particularly processed meat) as carcinogenic to humans (IARC, 2015). Furthermore, Food and Agricultural Organisation (FAO) reports have been critical of the ecological impact of high levels of meat consumption (Tubiello et al., 2014) and government white papers (e.g. Defra, 2013a; Foresight, 2011) have highlighted the need for a reduction in meat (particularly red meat) consumption. Dietary changes however, may be required to reduce the consumption of meat products (Bajželj et al., 2014; Tukker et al., 2008). Meat substitutes are plant-based meat alternative products that look and taste like meat and could potentially play a role in stimulating dietary change (Hoek et al., 2011; de Bakker and Dagevos, 2012). However, there is a lack of research that examines the factors that encourage consumers to partially replace meat with meat substitutes (Schösler et al., 2012).

In the academic literature, it has been reported that many consumers consider meat products to be an important source of nutrients and a traditional component of their diet (Verbeke et al., 2010). However, high levels of meat consumption have been associated with health conditions including cardio vascular diseases, type 2 diabetes and some forms of cancer (Troy and Kerry, 2010; Olmedilla-Alonso et al., 2013), as well as the global obesity epidemic (Vergnaud et al., 2010), which affects a fifth of the world's

* Corresponding author at: Room 209, Newcastle Business School, Northumbria University, City Campus East 1, Newcastle upon Tyne NE1 8ST, UK.
E-mail address: c.apostolidis@northumbria.ac.uk (C. Apostolidis).

http://dx.doi.org/10.1016/j.foodpol.2016.11.002
0306-9192/

adult population (Sofi et al., 2010). In addition to health related concerns, increasing meat production and consumption have also been identified as one of the main drivers of environmental and social pressures (Westhoek et al., 2014; Krystallis et al., 2012), as meat products have been associated with an inefficient conversion rate of feed to meat protein, high greenhouse gas emissions, deforestation, biodiversity loss and several cases of food safety risks (Hallström et al., 2014; Nijdam et al., 2012; Defra, 2013a). As a result, increasing attention is being placed on understanding the benefits associated with diets based less on meat and more on plant protein to allow the development of effective meat-reduction or meat-substitution policies and strategies (Hallström et al., 2014; de Boer et al., 2014).

To develop effective interventions and policies however, there is a need for researchers to better understand the factors that encourage consumers to eat less meat and investigate the role that meat substitute products can play in reducing meat consumption. As specific consumer groups may have different preferences regarding meat and meat substitute products (Hoek et al., 2011; Nocella et al., 2012; de Jonge and van Trijp, 2014), identifying segments of consumers with preferences for different meat or meat substitute attributes will also contribute to existing knowledge. Therefore, in order to address gaps in existing literature and answer calls for further research in this area (e.g. Schösler et al., 2012; Vanhonacker et al., 2013) an objective of this paper is to identify the attributes of meat and meat substitutes that influence consumer choices. In addition, we aim to elicit consumer preferences for these attributes and identify segments of consumers based on these preferences in the interest of establishing ways to reduce meat consumption through substitution. Drawing on McFadden's (1973) Random Utility Theory, we use labels to communicate information on specific attributes of meat and meat substitutes and develop a choice experiment to measure consumer preferences and segment consumers. Our results will provide valuable insights for policymakers, businesses and practitioners seeking to more accurately understand the factors that may hinder or encourage a dietary transition and therefore enable the development of more effective policies and strategies for reducing high levels of meat consumption (Tucker, 2014; Schösler et al., 2012). Ground meat, which in the UK is called mince, is the focus of this study as it is one of the most frequently consumed meat products due to its relatively low price and because it comes in a variety of different types, including meat free mince substitutes (de Boer et al., 2014; Mintel, 2013a). According to EBLEX (2013), the main organisation for the English beef and sheep industry, mince is the most commonly purchased type of beef accounting for 37% of the retail expenditure for beef (over £750 million). Additionally, Keynote (2013) reports that turkey mince was one of the drivers of the increase of turkey consumption, while meat free mince is one of the most successful products in the meat substitute market (Mintel, 2013a).

Our paper is structured as follows. In the next section we review the recent literature around meat consumption, the concept of meat substitution and the significance of food policy to encourage more sustainable meat consumption patterns. Next, we describe the choice experiment setting in detail including the attribute selection, choice design and the modelling approach followed in the analysis. In the next section we present the results of the analysis before discussing our findings and their policy implications. Finally, in our concluding section we describe this study's limitations and identify areas for further research.

2. Literature review

Western diets are characterised by a high intake of animal products that is above dietary recommendations (Westhoek et al., 2014). Several countries, including Germany (German Council for Sustainable Development, 2013), Netherlands (Health Council of the Netherlands, 2011) and the USA (U.S. Department of Agriculture, 2015), have reported high levels of meat consumption and the need for moderating meat in consumer diets to substantially reduce the global pressure on public health, the environment and society. In the UK, the Department of Health (2011) reports that meat consumption will need to drop by approximately 70% from an average 226 g/day for men and 163 g/day for women today, to about 70 g per person/day to reach healthy levels (Westland and Crawley, 2012).

Reducing the quantity of meat consumed in the average Western diet however, may require a profound societal transition because meat holds a special status in many societies (deFrance, 2009), is one of the most popular food products in many countries (Vanhonacker et al., 2013) and is generally perceived as healthy food (Verbeke et al., 2010). Therefore, wholesale changes in consumer diets may not be easily achieved in the short term due to tradition, cultural values and hedonistic lifestyles (de Bakker and Dagevos, 2012). Many consumers remain unwilling to reduce their meat consumption, although they are aware of several meat related concerns (Tucker, 2014; Schösler et al., 2014). Asking consumers to eat less meat may also result in a resistance to change and cause confusion regarding the products they could substitute meat with (de Boer et al., 2014). In addition, meat producers, processers and other stakeholders are likely to develop counter-strategies to resist changes that favour meat consumption reduction (Foresight, 2011).

In the extant literature, suggested meat reducing interventions include the promotion of one or more meatless days, encouraging consumers to reduce the portions of meat in meals, supporting and furthering replacement of meat with meat free (or partly meat free/hybrid) substitutes and encouraging cultural and lifestyle changes to influence consumption practices (de Boer et al., 2014; Laestadius et al., 2014; Sutton and Dibb, 2013; de Bakker and Dagevos, 2012). From a policy perspective, although there are different regulatory options to promote these changes and encourage sustainable meat consumption, according to Spiller and Nitzko (2015), measures to influence consumer decisions can be divided into three general categories: *consumer education, financial incentives and regulatory mechanisms*. Studies suggest that exploring different strategies to encourage sustainable food consumption and building alliances with modern consumers that take into consideration social diversity can be a useful step forward for the sustainability agenda (Spiller and Nitzko, 2015; Dagevos and Voordouw, 2013).

Food labelling is one of the recommended approaches to encourage consumers to move to more sustainable meat consumption patterns (Spiller and Nitzko, 2015). The UK is considered a European front-runner for promoting nutrition labelling on food and especially front-of-pack signposting (Draper et al., 2013; Grunert et al., 2010). The understanding and use of labels such as Guideline Daily Amounts (GDA), traffic light labels and other nutrition related logos is higher for UK consumers, than residents of other European countries such as Sweden, Germany or France (Van Kleef and Dagevos, 2015; Grunert et al., 2010). In their recent review of literature on nutritional labelling however, Van Kleef and Dagevos (2015) report that to date, researchers have focused mainly on the issue of understanding food labels and less on if these labels will actually lead to changes in food consumption. In addition to nutrition labels, other food labels have been recommended as effective ways to communicate the production related characteristics of meat and meat substitutes, including production method, environmental impact, origin and type of product (de Jonge et al., 2015; Van Loo et al., 2014; Koistinen et al., 2013; Hoek et al., 2011).

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Although food labels can be effective tools for communicating important information such as nutrition characteristics, carbon footprint and country of origin, as a stand-alone intervention they may be ineffective at changing consumer behaviour (Boztuğ et al., 2015; Grunert et al., 2014; Gadema and Oglethorpe, 2011). This is because the plethora of information consumers receive in the market place means only the information regarding product attributes that consumers consider important will have an impact on consumer behaviour (Akdeniz et al., 2013). For example, in a study of meat consumers in Finland, Koistinen et al. (2013) found that specific meat attributes such as fat content, production method and carbon footprint will have a different impact on the choices and willingness to pay, for different segments of consumers. Additionally, some labels are only adopted by industry on a voluntary basis. For example, although carbon footprint labels are popular in a number of industries that try to demonstrate their concern about sustainability and the environment, the meat industry is still reluctant to follow this trend (Röös et al., 2014; Röös and Tjärnemo, 2011). Nevertheless, labels can be used to complement other strategies to achieve a change in consumer behaviour, such as taxes and subsidies, education, new product development and informational campaigns (Laestadius et al., 2014; Dagevos and Voordouw, 2013; Nordgren, 2012), as a combination of approaches is more effective at changing consumer diets than isolated interventions (de Bakker and Dagevos, 2012; Nederkoorn et al., 2011; Tiffin and Arnoult, 2011).

In terms of education, some scholars suggest that developing campaigns to inform consumers can be an effective approach to increasing consumer awareness, encouraging changes in meat consumption, and supporting the acceptance of further meat reduction policies (Dagevos and Voordouw, 2013; Sutton and Dibb, 2013). However, other researchers have questioned the effectiveness of informational campaigns to reduce meat consumption, as meat is a product deeply rooted in many cultures and argued that price based instruments, that attempt to address the discrepancies between private and social costs (e.g. taxes), may be more appropriate (Edjabou and Smed, 2013).

The effectiveness of taxes and other financial incentives as interventions for reducing meat consumption has been debated in the academic literature (e.g. Säll and Gren, 2015; Nordgren, 2012). Taxation to change meat consumption is controversial as such strategies are often not feasible on a global scale, may have high monitoring costs and may face opposition from meat producers, politicians and consumers (Edjabou and Smed, 2013; Nordgren, 2012; Wirsenius et al., 2010). Furthermore, higher food prices may have a negative impact on the food security of the lower income households/families. Although research suggests that in Hungary the junk food tax could be effective in reducing the consumption of junk food (Bíró, 2015), the fat tax in Denmark (Jensen and Smed, 2013) was abolished two years after its implementation due to opposition from the food industry and lobbyists and after being criticised for being poorly designed from health professionals, politicians and the public (Bødker et al., 2015).

3. The role of meat substitutes in more sustainable meat consumption patterns

An alternative approach to actual meat reduction could be replacing meat with meat substitutes. Meat substitutes, which are also commonly referred to as meat alternatives or meat-free products, are usually derived from soybeans (Tofu), algae and dairy products (e.g. Valess), plant proteins (Ojah) and mycoprotein (Quorn) which are sold as burgers, stir fry cubes and as mincemeat and resemble the taste and texture of meat (Mintel, 2013a; Schösler et al., 2012). Studies report that many meat substitutes have a lower ecological footprint in terms of carbon footprint, land use and energy use (Nijdam et al., 2012) and are perceived by some consumers to have a healthier image than meat (Elzerman et al., 2013). Meat substitutes produced from grains or vegetables are more carbon efficient (Nijdam et al., 2012) have a lower fat content, less salt, require less water for production and produce a smaller land-use foot print than red meat products (Hoek et al., 2011). In the UK, a number of meat substitutes are produced nationally such as the market leading meat substitute brand Quorn (Mintel, 2014) while several stores offer meat substitutes from organic sources (Schösler et al., 2012). In addition, Linda McCartney, a meat free company owned by the large organic food brand Hain Daniels Group saw an increase in sales volumes of 50% in the period 2014–2015 (Mintel, 2015).

Although there has been some growth in the consumption of meat substitutes in the UK and Europe as a whole, the market is still very small at 3.6% of the market value of meat (Mintel, 2013a, 2013b; Hoek et al., 2011). As low levels of acceptance for meat substitutes have been associated with food neophobia, lower perceived product quality, perceived healthiness and higher prices in comparison to meat, efforts aimed at transitioning diets towards lowering meat consumption levels through substitution face difficulties (Elzerman et al., 2013; Vanhonacker et al., 2013; Hoek et al., 2011). Nevertheless, the consumption of meat substitutes is increasingly popular amongst vegetarians who avoid meat and meat reducers who are actively seeking to reduce their meat consumption (van Dooren et al., 2014; Hoek et al., 2011) due to religious, animal welfare, health and environmental concerns (Radnitz et al., 2015; Piazza et al., 2015). There may therefore be a potential for using meat substitutes to encourage less meat-based lifestyles which in turn may offer promising opportunities for reducing the social, environmental and economic impact of consumer diets. Although information on the preferences of vegetarians and meat reducers, and the reasons why they consume meat substitutes or reduce meat consumption, could provide useful information to marketers and policy makes, most of the extant literature has ignored these consumer groups (Vanhonacker et al., 2013; de Bakker and Dagevos, 2012). Furthermore, although the benefits of meat substitutes have been advocated frequently, no UK studies have looked into consumer preferences for the attributes of meat and meat substitutes and the trade-offs between these attributes which can encourage meat substitution and a transition to less meat-based diets. The development of effective meat reduction and substitution policies and strategies requires more insight into: (1) the attributes that may hinder or encourage a transition to a less meat based diet and (2) how the information consumers receive in the market place regarding these attributes influences their choices (Tucker, 2014). Moreover, as preference heterogeneity for meat characteristics may be very large (Van Loo et al., 2011), it is important to identify consumer segments based on these preferences. Although previous studies have identified market segments based on consumers' preferences for various meat attributes (Koistinen et al., 2013; Latvala et al., 2012; Van Loo et al., 2014; de Jonge and van Trijp, 2014) to the best of our knowledge previous research has not compared the attributes of both meat and meat substitutes. Understanding these factors will assist in the development of more effective 'cutting down' and substitution strategies and policies as well as the production of more attractive meat substitute products (de Boer et al., 2014; Krystallis et al., 2012; Troy and Kerry, 2010).

4. Methodology and methods

In this paper we use Random Utility Theory (RUT) as the theoretical framework to examine UK consumer preferences for

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

the different health, society and environment related attributes of meat and meat substitutes. A research approach that employs RUT to examine consumer preferences is Discrete Choice Experiments (DCE). DCEs can provide results that have high external validity (Louviere et al., 2000) and are strongly related to actual market shares (Mueller et al., 2010a, 2010b) as they force consumers to trade off desirable and undesirable product attributes. The DCE approach to evaluating consumer preferences towards meat attributes and inform food policy has been advocated by other authors (e.g. Van Loo et al., 2014; Van Wezemael et al., 2014; Grebitus et al., 2013). In addition, DCEs have been associated with other research benefits such as reducing respondents' hypothetical bias (i.e. deviation between stated and actual behaviour) (Hoyos, 2010). For our study, data collected as part of our DCE is analysed using a multinomial logistic regression model, to examine the effect of attributes on choice behaviour.

According to McFadden (2001), RUT argues that individuals make their choices based on a latent construct, named utility. This utility (U), of an individual n, can be separated into the observed utility (V), and the independent identically distributed error (e). According to RUT, an individual n's utility (U_i) for alternative i in choice occasion t is the sum of the observable and the unobservable (random) utilities as seen in (1):

$$U_{int} = V_{int} + e_{int} \tag{1}$$

Lancaster's (1966) theory of consumer choice suggests that observed utility, can be described as a function of the attributes of alternative i, as shown in (2):

$$V_i = \beta_0 + \sum_{k=1}^{K} \beta_k X_k \tag{2}$$

In (2) the observed utility V_i is described as the sum of the group of attributes X describing alternative i and β, the parameters associated with the various levels of specific attributes. Therefore, for alternative i to be chosen over alternative j, the utility associated with the first alternative (U_i) must be higher than the one associated with alternative j (U_j) meaning $U_i > U_j$. In particular, for this study, the utility V_{ij}, is assumed as the linear function (3) of fat content (Fat), carbon footprint (Carbon), type of mince (Type), production method (Method), region of origin (Origin), brand (Brand) and price of purchase (Price):

$$V_{ij} = \beta_0 + \beta_1 Fat_{ij} + \beta_2 Carbon_{ij} + \beta_3 Type_{ij} + \beta_4 Method_{ij} + \beta_5 Origin_{ij} + \beta_6 Brand_{ij} + \beta_7 Price_{ij} \tag{3}$$

Following this utility maximisation principle, the probability that an individual will choose alternative i over alternative j as shown in (4):

$$P_i = P(i|J) = P(V_i + e_i > V_j + e_j) \quad \text{for all } j \in J, \text{ where } j \neq i. \tag{4}$$

Finally, the probability of individual n, choosing alternative i in choice set t is (5):

$$P_{int} = \frac{exp(\beta X_{int})}{\sum_{j=1}^{J} exp(\beta X_{jnt})} \tag{5}$$

Since all level utility values are measured using a common unit, ranges of utilities within attributes can be compared to calculate their relative importance for consumer preferences (Baba et al., 2016). In order to calculate the relative importance of an attribute, the highest and lowest level utility values of each attribute need to be determined. The difference between these two values within an attribute is the utility *range* for each attribute. Once the utility ranges for all attributes in an experiment are calculated the relative attribute importance is derived by dividing each attribute's range by the sum of the ranges of all attributes and is expressed as a percentage of the sum of the utility ranges for all attributes (Baba et al., 2016; Lüthi and Prässler; 2011). As shown in Eq. (6) the relative importance (RI) of an attribute a_1 from a group of examined attributes a_x is defined as:

$$RI_{a_1} = 100 \times \frac{range(a_1)}{\sum range(a_x)} \tag{6}$$

When a heterogeneity in preferences needs to be considered, this can be examined using a latent class approach where the individuals are sorted into a number of segments (latent classes) each composed of homogeneous consumers (Boxall and Adamowicz, 2002). To estimate the probability that a respondent belongs in a particular segment, Eq. (5) is adjusted to estimate the conditional choice probability - in layman's terms the choice probability given membership in a particular segment s as shown in (7).

$$P_{ji|s} = \prod_{t(n)}^{T(n)} \frac{exp(\beta_s' Xint)}{\sum_{j=1}^{J} exp(\beta_s' Xjnt)} \tag{7}$$

This time β' is a segment-specific parameter, and $t_{(n)}$ a specific choice occasion from the $T_{(n)}$ set of choice occasions of individual n. The unconditional choice probability of a set of choices is then calculated by combining this conditional choice probability with the marginal membership probability (P_s), meaning the probability that individual n belongs in segment s as presented in (8) below.

$$P_{(s)} = \frac{exp(\lambda_s Z_n)}{\sum_{s=1}^{S} exp(\lambda_s Z_n)} \tag{8}$$

where λ_s are segment-specific coefficients that demonstrate whether the variable Z_n, a variable describing the consumer, increases the probability that individual n belongs to segment s. The unconditional choice probability is calculated as shown in (9):

$$P_{ji} = \sum_{s=1}^{s} P_s \prod_{t(n)}^{T(n)} P_{jit|s} \tag{9}$$

After the model is estimated, probabilities are obtained for each individual latent segment (Hu et al., 2004):

$$P_{(s)}^{P} = \frac{P_s \prod_{t(n)}^{T(n)} P_{jit}}{\sum_{s=1}^{s} P_s \prod_{t(n)}^{T(n)} P_{jit|s}} \tag{10}$$

5. Selection of choice attributes and levels

The first step of our DCE involved the characterisation of meat and meat substitute mince products through a series of attributes and attribute levels. In order to design our DCE, we needed to validate the attributes that should appear in the choice tasks, through a systematic review of academic literature and government reports on meat products and meat consumption (e.g. DEFRA, 2013a; Tubiello et al., 2014; Van Loo et al., 2014; Van Wezemael et al., 2014). The importance of these attributes for UK consumers was subsequently validated through a series of four focus groups, an attribute validation method recommended by several researchers (e.g. Coast et al., 2012; Louviere et al., 2000) and used in similar studies (Nocella et al., 2012; Carlsson et al., 2007).

During the focus groups, participants discussed the product attributes that would influence their consumption of meat and meat substitute products. The discussions included both traditional, 'old' attributes, that participants felt they are more familiar with (e.g. price and fat content) and 'newer', less familiar attributes (such as carbon footprint and GM products). The findings of the focus groups were categorised into six major themes which validated the social and environmental concerns that are currently

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

drawing the attention of public media, academics and policy makers:

- Fat content
- Carbon footprint
- Type of mince
- Method of production
- Price
- Origin

Based on these findings, a choice experiment was developed to elicit consumer preferences for the identified attributes. To enable people make realistic choices, the levels in Table 1 were identified for the validated attributes, based on information from the focus groups, market research, consultation with experts on food production, relevant literature and pilot tests (Coast et al., 2012). Table 1 also includes the description of the attributes provided to the respondents at the beginning of each survey. Although some attribute descriptions were not overly detailed (to avoid respondent fatigue or information overload), the questionnaire introduction included the information that was considered essential for the respondents to be able to complete the survey.

The four largest (in terms of market share) food retailers (Mintel, 2011) were visited to find levels for the relevant attributes. A list of products and the associated levels (such as prices of different mince products) was constructed to develop the levels to be included in the experimental design, always in compliance with two criteria. Firstly, levels should be realistic and secondly, they should support trade-offs between attributes (Coast et al., 2012). For example, prices for products ranged between £2–5 (beef), £2–5 pork, £3–5 (turkey), £3–5 (lamb) and £2–5 for meat free mince. Prices depended on the production method (organic, conventional) and the country of origin (such as UK or imported) with the higher prices for each type of mince being charged for UK produced, organic mince. Additionally, market reports (e.g. Mintel, 2013a; EBLEX, 2013) were also used to identify appropriate levels for the experiment attributes (e.g. most popular types of meat). Although market research provided sufficient information on realistic, trade-off supporting levels for most attributes, there was a lack of accurate market information for carbon footprint. As discussed earlier, carbon footprint labels are not commonly used in the UK meat sector, but were identified by focus groups as an important factor that influences consumer preferences. Therefore, secondary data was used to develop the levels for carbon footprints. Information on the carbon footprints of meat/meat free products was obtained through a review of published studies (see Table 2). Following the advice of previous authors to make the levels realistic (e.g. Coast et al., 2012), the findings of the academic literature review were presented to professionals working in the food sector and familiar with the Life Cycle Analysis (LCA) process in order to decide and validate the carbon footprint values used in the experiment. The findings provided realistic carbon footprint levels for the meat types involved in the survey, which were later pilot tested.

Although attributes can be effectively described verbally, the use of visual attribute descriptions can provide more reliable findings due to the closer simulation to the real market environment (Mueller et al., 2010a; Jaeger et al., 2001), as the use of actual labels and logos can influence consumers' choice of food products (Van Loo et al., 2011). In the current study, in line with the Food Standard Agency's (2013a) recommendations, fat content was presented using grams of fat per 70 g portion, percentage GDA and the

Table 1
Attribute descriptions and levels.

Attribute	Description	Levels
Fat content (g per 70 g portion and% GDA)	Amount of fat per portion in grams and also in percentage compared to the daily needs according to GDA guidelines for healthy adults	2% (1.5 g) 5% (3.5 g) 10% (7 g) 15% (10 g) 25% (17 g)
Carbon footprint (kg CO_2 per 500 g pack of product)	The amount in (kg) of greenhouse gas (GHG) emissions caused by the production and consumption of 500 g of the food product	1 kg 3.5 kg 6 kg 13 kg 20 kg
Method of production	Organic food is produced using methods that do not involve modern synthetic inputs such as artificial pesticides and chemical fertilisers. Organic food is produced taking into consideration environmental protection and animal welfare and is not using irradiation, chemical food additives or other materials not authorised for use in organic production. GM free food does not derive from genetically modified organisms	Organic Not organic/GM free Conventional
Type of mince	Whether it is coming from an animal source- pork, turkey, lamb, beef- or from a non-animal source (meat substitute) such as soya, tofu, Quorn etc	Beef Turkey Lamb Pork Meat free
Brand	The brand, or point of purchase, of the mince product	My butcher Quorn Supermarket own label
Region of origin	Product has a label that identifies the region or country in which it was produced (in case of animal products born, raised and processed)	Locally produced UK Imported (EU country) Imported (non EU country)
Price	The price is expressed in pounds (£) per 500 g pack of products	£2 £3 £4 £5

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Table 2
Carbon footprint ranges per type of product in the literature.

Type of meat	kg of CO_2 per kg of product	Authors
Beef	14–39 kg	Röös et al. (2013), Hamerschlag and Venkat (2011) and Nguyen et al. (2010)
Pork	4.1–8.9 kg	Röös et al. (2013) and Hamerschlag and Venkat (2011)
Lamb	39–51.7 kg	Ripoll-Bosch et al. (2013) and Hamerschlag and Venkat (2011)
Turkey	4–10.9 kg	Hamerschlag and Venkat (2011)
Meat Free	2–6.8 kg	Röös (2012), Hamerschlag and Venkat (2011) and Finnigan et al. (2010)

recommended by the Food Standard Agency traffic light label (green, amber, red) to communicate low, medium and high fat contents. Commonly used labels such as flags and type of mince logos were used to present the type and origin of mince. Although developing labels for all individual countries of origin would be unrealistic for this experiment, the mandatory information regarding the origin of the mince was provided in line with the European Commission Council Regulations (European Commission, 2013). These regulations mandate that since mince meat products may include meat from animals born and reared in different countries, product labelling should indicate whether the meat comes from EU member states or third countries. Therefore the experiment distinguished between domestic and imported products as well as between imported from EU and non-EU countries.

Price tags were employed to communicate realistic monetary costs for each alternative. Carbon footprint was presented using the Carbon Trusts official label, demonstrating a range of low to high carbon footprint values, while organic and GM free labels were used to describe different methods of production. In terms of organic products, EU laws set out the principles of organic production and define how organic products should be labelled. For a food product to be labelled 'organic', at least 95% of its ingredients should meet the necessary standards of organic production, which include synthetic inputs and additives as well as livestock feed. In addition organic production takes into consideration environmental protection, biodiversity and animal welfare (European Commission, 2007). According to the Food Standard Agency (2013b) although there is a mandatory EU labelling for GM food, it does not cover products such as meat, milk and eggs obtained from animals that have eaten GM feed. Additionally, although some European countries (e.g. Germany and France) have introduced national schemes for GM free food, in the UK there are no specific rules that govern the use of "GM free" claims on food labels. Nevertheless, claims can be made if they are accurate and not misleading (Food Standard Agency, 2013b). The complex nature of production methods (and particularly organic production) made the definition of the attributes and labels provided to the respondents at the beginning of the survey very challenging. Although an extensive definition of organic production has been provided to the respondents, it was not possible to cover the full extent of the details of organic meat production in a survey description without risking overloading the respondents with information. The description therefore covered the aspects of organic production that the authors considered more relevant to the study.

The first draft of our survey was pilot tested with 100 respondents in a supermarket environment to ensure comprehensiveness and confirm the survey instrument's face and content validity (Green and Gerard, 2009; Hoyos, 2010). The pilot survey identified that brand (or in the case of unbranded mince, the respondent's butcher) was an additional important attribute and therefore brand was added to the survey instrument for the final experiment. Choice levels for the "brand" attribute for meat/meat free mince were selected based on the leading brands for each type of mince: for meat free mince; Quorn and supermarket own label levels; and for meat; mince from local butchers and supermarket own label mince levels (Mintel, 2013a, 2014).

Having adopted the DCE approach, the next step was to decide on the number of choice tasks and alternatives for each task and which alternatives should be included in each task. As a full factorial design would have to include a large number of combinations ($5^3 4^2 3^2 = 18{,}000$ combinations), a fractional factorial design was required. We used the Sawtooth CBC software package to generate the statistical design. The program produces a predetermined number of designs, focusing on ensuring level balance and near-orthogonality for each respondent (Johnson et al., 2013). This approach reduces context effects and correlations among interactions (common in fixed designs) and therefore can effectively estimate both main effects and 2-way interactions (Hoen and Koetse, 2014).

Although the procedure followed by the Sawtooth software does not provide a D-efficiency value for the model, as it assumes that "*designs that are level balanced and near orthogonal will lead to identified preference-model parameters*" (Johnson et al., 2013, p.11), the software allows simulations using dummy data to test the integrity of the design. It then computes the relative standard errors of the utilities for each level as well as the strength of the model. In order to measure the D-efficiency of our model (i.e. how the model designed can estimate the parameters with respect to another model), we also compared the strength of our fractional factorial design to the strength of a complete enumeration design, which considers all possible combinations of the attributes (Hoen and Koetse, 2014). Our model was approximately 80% as efficient as the complete enumeration design. Furthermore, standard errors of the utilities estimated from the simulations were balanced across respondents and within acceptable levels (well below 0.1).

Using this strategy we generated a choice experiment design which included four survey versions which were similar in design, with each version including 20 choice tasks (see Appendix A for a sample choice task). The choice tasks in each survey version were different from the ones in the other versions. Each choice task presented respondents with three mince products, described based on the seven experiment attributes, using a combination of attribute levels to allow level balance and a near orthogonal design within each version of the survey. This means that although not all levels for all attributes would appear in one single choice task, in each version of the survey, all levels of an attribute would appear equally, enabling fair calculation of consumer preferences for every level. In each choice task respondents were asked to choose between the three alternative options and an opt-out option. The opt-out option was available in case respondents did not choose any of the available products, either because their characteristics were not of interest to them or because they found the choice task too complicated to make an informed decision. Additionally, the opt-out option was particularly useful in the case of vegetarian consumers as they were not forced to choose any of the available meat or meat-substitute if they did not find any of them appropriate. This allowed us to accurately measure preferences also for vegetarian consumers.

Data was collected from May 2013 to January 2014, from two UK regions with diverse reported patterns of meat and meat substitute consumption, the Northeast and Southeast of England. The Northeast of England is one of the regions with the largest meat consumption in the UK, however the consumption of meat substitutes is not common. On the other hand the Southeast has the lowest reported meat consumption, but the consumption of meat substitutes is higher than other areas of the UK (Defra, 2013b; Mintel, 2014). The surveys took place inside actual food

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Table 3
Demographic characteristics of the sample and the UK population (n = 247).[a]

		N	Sample%	UK%
Consumption group	Meat eaters	200	81%	81%
	Meat reducers	33	13%	13%
	Vegans/vegetarians	14	6%	6%
Gender	Male	114	46%	49.1%
	Female	134	54%	50.9%
Age	18–25	35	14.1%	11.8%
	26–35	39	15.7%	35%
	36–45	46	18.5%	
	46–55	46	18.5%	17.5%
	56–65	40	16.1%	16.3%
	>65	41	16.5%	19.6%
Household income	<£10,000	24	9.7%	15%
	£10,000–19,999	101	40.9%	44%
	£20,000–29,999	56	22.6%	21%
	£30,000–39,999	27	10.9%	10%
	£40,000–49,999	24	9.7%	5%
	>£50,000	15	6.1%	4%
Household members	Children	99	39.9%	36.2%
	Partner/spouse	198	79.8%	81.6%
	Other adults	33	13.30%	13.2%
	Only myself	33	13.30%	12.3%
Food shopper	Sole household food shopper	172	69.4%	
	Joint household food shopper	37	14.9	
	Not main household food shopper, but still shops for food	39	15.7	
Other reasons for meat avoidance	Yes	25	10.1	
	No	223	89.9	

[a] Based on information from Office for National Statistics (2013) and Mintel (2013b).

retailers such as Sainsbury's, Morrisons, and Tesco. The questionnaire was administered and their completion supervised by experienced interviewers using face-to-face interviews. The target population was over 18 years old, with specific quotas according to age, gender and consumption patterns regarding meat products representing UK population according to government statistics (Defra, 2013b) and information from earlier market research (Mintel, 2013b). A cheap talk approach has also been adopted by the interviewers as an attempt to reduce the hypothetical bias, by discussing with the respondents the individual's tendency to exaggerate their stated preferences during the questionnaire completion (Carlsson et al., 2007). The portion size (70 g) was communicated to the respondents both verbally and in written in the key of the questionnaire were the attributes and levels (e.g. GDA and carbon footprint) were described to the respondents.

6. Analysis and results

A quota sample of vegetarians, meat reducers and meat eaters was targeted (Mintel, 2013b; Food Standards Agency, 2009), consisting of 200 meat eaters (81%), 33 meat reducers (13%), and 14 vegetarians (6%) which have characteristics that are approximately representative of the demographics of the UK population (Table 3).

Approximately 70% of the respondents were the main food shoppers in their household, while an additional 15% were jointly food shopping. This was expected since the surveys took place inside actual food retailers where the number of food shoppers is high. Main food shopper status is associated with higher involvement (Drichoutis et al., 2005), a better knowledge of the market (Reed et al., 2003) and a higher control over the resources and the nature of the food products that enter a household (Schmeer, 2005; McEachern and Schröder, 2002). Therefore, the high percentage of main food shoppers in the sample increases the reliability

Table 4
Results of choice experiment analysis (n = 247).[a]

Log likelihood	−5210.832		
Percent certainty	35.726		
Chi-square	5548.448		
	Variable	Utility	Std error
Fat content	2% (1.5 g)	0.552	0.038***
	5% (3.5 g)	0.468	0.037***
	10% (7 g)	0.116	0.038***
	15% (10 g)	−0.263	0.043***
	25% (17 g)	−0.873	0.051***
Carbon footprint	1 kg/500 g	0.340	0.039***
	3.5 kg/500 g	0.207	0.039***
	6 kg/500 g	−0.052	0.041
	13 kg/500 g	−0.148	0.042***
	20 kg/500 g	−0.347	0.043***
Type of mince	Beef	1.002	0.039***
	Turkey	−0.196	0.043***
	Lamb	0.079	0.040**
	Pork	−0.203	0.047***
	Meat free	−0.673	0.072***
Brand	Quorn	−0.160	0.077***
	Butcher shop unlabelled	0.442	0.048***
	Super market own label	−0.282	0.041***
Method of production	Organic	0.095	0.026***
	Not organic/GM free	−0.022	0.026
	Conventional production	−0.073	0.026***
Origin	Imported (EU country)	−0.258	0.036***
	UK	0.564	0.032***
	Local	0.534	0.032***
	Imported (Non-EU country)	−0.841	0.042***
Price	£2	0.556	0.031***
	£3	0.358	0.033***
	£4	−0.413	0.037***
	£5	−0.501	0.038***
	NONE	−0.094	0.044***

[a] ** Indicate significance at the 0.05 level. *** Indicate significance at the 0.01 level.

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

and the validity of the experiment. In addition, 25 respondents (10%) reported that there are other reasons influencing their meat consumption, with religion being the most common reason for the avoidance of particular types of meat.

The data was analysed using Sawtooth Choice-Based Conjoint dedicated software to estimate coefficients for the individual utilities of each attribute level. The results from the multinomial logistic regression analysis are presented in Table 4. Effects coding was used, where the levels of the attributes are coded so that the utilities add up to zero in each attribute category. The results demonstrate the utility value for each level, as well as whether the utility value was significant at the 0.01 or 0.05 level. The utility values can be compared within an attribute to examine consumer preferences for the levels of that attribute- the higher the utility associated with a particular level within an attribute, the more value this level holds for the respondents. Since the presented utilities are zero-centered (and therefore sum to zero), there are utility values that are negative. This does not necessarily mean that these levels are repelling, or have a negative influence on consumer choices, but that they are less appealing than the positive utility values (Tabi et al., 2014; Childs et al., 2008).

It can be seen that apart from two exceptions, all of the attribute levels have a significant impact on consumer preferences. The two exceptions are the middle value of carbon footprint (6 kg/500 g) and the GM free level of the method of production attribute. Associated utilities for price dropped as prices increased showing that consumers are less willing to pay higher prices for the same product. This is consistent with a priori expectations based on economic theory and earlier studies (e.g. Koistinen et al., 2013; Realini et al., 2013; Loureiro and Umberger, 2007) and can be considered an indication of the theoretical validity of the experiment's results. The decreasing utilities for increasing fat content is in line with reported findings from previous food preference studies, reporting a negative direction of effect in the case of fat content (e.g. Realini et al., 2013; Koistinen et al., 2013). Imported products (both from EU and non-EU countries) are also associated with low utilities compared to the UK and even more, local production. In line with literature and market research information (Koistinen et al., 2013; Mintel, 2015) beef is the type of mince with the highest associated utility, followed by lamb. Pork and turkey had negative utility values, indicating a weaker preference for these types of mince. Meat free mince was the type with the lowest associated utility in the aggregated analysis.

In addition to the individual level utilities, in Fig. 1, the relative importance of each attribute is presented which can be used to examine the relative level of impact of each attribute on consumers' choices (Silayoi and Speece, 2007; Mueller et al., 2010a, 2010b). It is clear that type of mince is the attribute with the highest relative importance (23.4%), and has the strongest influence on consumers' choices, followed by fat content and region of origin (20% and 19.7% respectively). Price (14.8%), carbon footprint (9.6%), brand (10.1%) and method of production (2.4%) have lower relative importance levels.

7. Latent class analysis results

Latent class analysis aims to segment respondents based on their preferences for the product attributes that influence their

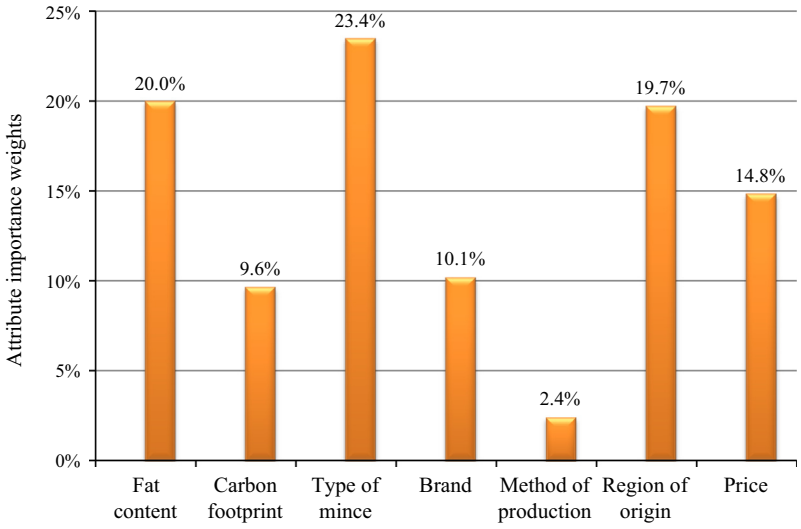

Fig. 1. Results of relative attribute importance analysis (n = 247).

Table 5
Criteria for number of segments (n = 247).

Groups	Log-likelihood	AIC	CAIC	BIC	ABIC
4	−2894.028	5930.055	6441.858	6370.858	6145.255
5	−2711.552	5623.105	6297.912	6202.912	5901.048
6	−2594.296	5426.592	6284.403	6165.403	5787.279
7	−2492.937	5271.874	6302.688	6159.688	5705.304
8	−2379.427	5092.853	6296.671	6129.671	5599.027
9	−2351.649	5085.298	6462.120	6271.120	5664.216

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Table 6
Relative attribute importance per segment (n = 247).

	Price Conscious (42.5%, n = 105) (%)	Green (17%, n = 42) (%)	Taste driven (14.6%, n = 36) (%)	Healthy (10.5%, n = 26) (%)	Organic (9.7%, n = 24) (%)	Vegetarian (5.7%, n = 14) (%)
Fat content	17.5	14.7	10.9	32.1	30.9	26.0
Carbon	9.6	26.6	6.0	6.6	12.3	7.8
Type of mince	27.0	15.0	27.3	20.4	24.3	32.4
Brand	3.4	7.6	19.2	12.6	3.6	7.8
Method of production	1.5	6.5	8.7	4.3	12.1	8.3
Region of origin	21.4	19.0	14.7	16.8	2.5	9.6
Price	19.6	10.7	13.2	7.3	14.3	8.2

Table 7
Chi-square analysis results (n = 247).

		Price conscious (%)	Green (%)	Taste driven (%)	Healthy (%)	Organic (%)	Vegetarian (%)	Chi square/*p-value*
Gender	Male	50.5	38.1	60.6	23.1	83.3	28.6	23.655 *<0.001*
	Female	49.5	61.9	39.4	76.9	16.7	72.5	
Age	18–34	14.0	45.2	45.5	7.7	79.2	42.9	117.603 *<0.001*
	35–55	64.5	31.0	18.2	0	0	35.7	
	>55	21.5	23.8	36.4	92.3	20.8	21.4	
Income	<20	66.4	28.6	24.2	23.1	100.0	28.6	92.307 *<0.001*
	20–40	32.7	33.3	39.4	42.3	0	64.3	
	>40	0.9	38.1	36.4	36.4	0	7.1	
Household	Children	25.2	14.6	36.4	34.6	54.2	26.7	13.572 *0.055*
	Partner	69.2	76.2	54.5	46.2	79.2	66.7	10.826 *<0.001*
	Other Adult	8.4	14.3	16.7	19.2	16.7	26.7	8.043 *0.154*
	Only myself	24.3	23.8	12.5	42.3	12.5	13.3	8.157 *0.148*
Region of residence	Northeast	22.3	9.3	5.3	4.0	5.3	2.0	3.941 *0.558*
	Southeast	19.8	7.7	4.5	6.5	4.5	4.0	
Consumer group	Meat eaters	97.2	45.2	100.0	76.9	100.0	0	333.405 *<0.001*
	Meat reducers	2.8	54.8	0	23.1	0	0	
	Vegetarian	0	0	0	0	0	100.0	

a. For every variable no more than 20% of the cells have expected count less than 5.
b. 50% of the consumer group cells have an expected count less than 5.

purchasing decisions. The first step in a latent class analysis is the identification of the number of segments (Nocella et al., 2012). The Akaike information criterion (AIC), the Bayesian information criterion (BIC) and corrected AIC (CAIC) as well as the significance and the signs of the parameters and the researcher's own judgement were used to determine the number of segments (Nocella et al., 2012; Ruto et al., 2008).

The Log-likelihood statistics suggested that the latent class approach improved the goodness of fit of the model. Initially, models with 4–9 segments were analysed (Table 5). The examination of the values of the four criteria deriving from the estimation process shows that there is a clear improvement of all four criteria up to the model with six segments. In the model with seven segments the CAIC criterion worsens slightly while the other criteria improve very little. However, in the model with eight segments all the criteria improve again before all of them worsen for the nine class model. Therefore it can be argued that the results indicate a model with six or eight segments is appropriate. An analysis of the percentages of improvement of the criteria between the six-segment and the eight-segment model shows that the improvement witnessed from the transition from five to six segments is slightly larger than the one from seven to eight segments (3.5% improvement in the AIC compared to 3.4% and 0.21% improvement to the CAIC criterion compared to a 0.001%). Additionally the direction of effects of the attribute levels was examined finding that the six segment model is better in terms of providing results consistent with a priori expectations. Therefore the six segment model was chosen for this research.

Table 1A in Appendix B presents the estimated level utilities for each segment. Most level utilities were statistically significant at the 99% level. Based on each segment's level utilities, the relative attribute importance for each segment was also calculated and is presented in Table 6. Six segments were identified and have been named according to the preferences of consumers in each segment. The results of the chi square tests that were used to test for significant differences for socio-demographic characteristics of the members of each segment are presented in Table 7. Statistically significant inter-segment differences exist regarding the gender, age, income, presence of children in the household, and the consumer group of respondents. Despite the reported differences in consumption patterns, there were no significant differences between consumers from the Northeast and the Southeast of

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

England which indicates that our findings have nationwide relevance.

8. Discussion of results

Our results indicate that cheap, low fat, beef mince produced in the UK, with a low price is the preferred mince product of respondents. The results also indicate that replacing meat with meat substitutes will be challenging, as meat substitutes have the lowest associated utilities for any type of meat. Respondents exhibited very low preferences for meat substitute products, probably due to product unfamiliarity, food neophobia or lower perceived quality (e.g. Elzerman et al., 2013; Vanhonacker et al., 2013; Hoek et al., 2011). Nevertheless, consumers placed high utilities on certain attribute levels commonly associated with meat substitutes, such as produced in the UK, low fat content and low carbon footprint. There is therefore potential for meat substitutes to partially replace meat in consumers' diets if interventions are developed based on these attributes, transforming food shopping from a habitual process to one that takes these characteristics into consideration.

To increase the effectiveness of potential meat substitution interventions, and in order to allow the development of targeted intervention as part of a holistic meat reducing strategy, six consumer segments have been identified. 'Price conscious' consumers formed the largest segment (42.5% of the respondents) and were strongly influenced by the price of meat, but also showed strong preferences for low fat, locally produced beef. The probability of a membership in the price conscious segment was increased by being 35–55 year old, low income, meat eater.

Fat content had a relatively strong influence on the choices of consumers for the majority of the segments, however 'healthy eaters' (10.5%) and 'organic consumers' (9.7% of the sample) exhibited the highest interest in fat content. Healthy eaters were mainly meat eating/reducing females over 55 years old while organic consumers were primarily younger male meat eaters. 'Green consumers' accounted for 17% of the sample and include relatively more high income female respondents, with a strong presence of meat reducers. This corroborates the findings of earlier studies which highlight the possible environmental benefits created by an increasing number of meat reducers (Verain et al., 2015; de Bakker and Dagevos, 2012; Aiking et al., 2006).

The 'taste driven' segment (14.6% of the sample) had high preferences for beef mince bought from their butcher. Taste driven consumers placed a relatively low value on the health related attributes such as fat content, which may be due to the reported link between meat fat content and perceived taste (Font-i-Furnols et al., 2012). Finally, 'vegetarian consumers' had very high preferences for meat substitutes, but only a moderate interest in the environmental impact of their consumption. This is the smallest segment and accounts for 5.7% of the sample. In line with earlier studies (e.g. Piazza et al., 2015) vegetarians appear to be interested in healthy eating and avoiding meat products for moral reasons. In line with the strong presence of meat reducers in the green consumer segment, this finding confirms that meat reducing consumers are more environmentally driven than vegetarians. As members of the vegetarian segment are the only ones that display already strong preferences for meat substitutes, they can be considered as early adopters of these products. According to Thøgersen and Zhou (2012) the first individuals who are willing to adopt an innovative product are vital for getting the diffusion process started and promoting it to more reluctant adopter groups. Hence, it is likely that efforts aimed at promoting meat substitutes can benefit from these early adopters building communication strategies around them acting as spokesmen, role models, and opinion leaders (Spiller and Nitzko, 2015).

The idea that there is considerable heterogeneity among consumers' preferences and attitudes has been also suggested in recent research on meat consumption and the findings of our analysis corroborate, but also contradict, findings of earlier studies. For example, Koistinen et al. (2013) used a similar approach to identify six consumer segments in the Finnish meat market. They focused on beef and pork and therefore excluded meat free substitutes and vegetarian consumers, however identified: a price conscious segment representing 23% of the market; a fat content conscious but not environmentally conscious 'healthy eaters' segment (23%); a 'taste driven' quality beef preferring segment (12%); and a segment heavily influenced by organic meat production (11%). Koistinen et al. (2013) also identified a segment with characteristics similar to our 'green consumer' segment, that was associated with meat avoidance and sensitive to carbon footprint information. They claim that these consumers are generally ideological but passive as their pro-sustainability attitudes are not reflected in their choices of meat products. We argue that the strong presence of meat reducers we identified as part of our 'green consumer' segment can explain the high meat avoidance and environmental sensitivity reported in the Koistinen et al. (2013) study.

Although this is the first study that has included both meat substitutes and meat products in the same choice experiment, our segments also have similarities with segments identified by other researchers, corroborating and contributing to their findings. In another study of the Finnish meat market, Latvala et al. (2012) also identified six segments that varied based on their willingness to reduce red meat consumption for health, environmental, method of production and taste reasons. Their results emphasise that heterogeneity is not only limited to consumer attitudes, but extends to the reasons to change meat consumption patterns as well. Furthermore, price conscious meat consumers were identified as one of six segments in a study of German meat consumers by Spiller and Nitzko (2015) who named this segment as 'bad influence' due to the strong influence of price in their choices which makes changing behaviour to address sustainability purposes more difficult. Spiller and Nitzko (2015) results are complementary to our findings and highlight the importance that vegetarians play as meat reducers. They argue that the vegetarian and sustainable consumer segments, may act as 'citizen consumers', influencing strategies and regulations.

Similar to previous studies (e.g. Koistinen et al., 2013; Latvala et al., 2012; Spiller and Nitzko, 2015) age, gender and income varied between segments. Nevertheless, profiling the classes in terms of socio-demographic variables provided altogether only a weak explanation for the existence of the heterogeneity. Generally in line with earlier studies more taste driven, meat eating segments are male dominated, while on the other and sustainable and healthier consumer segments are reported to be mostly female and younger consumer dominated (Koistinen et al., 2013; Latvala et al., 2012; Spiller and Nitzko, 2015).

9. Policy measures to encourage meat substitution and sustainable meat consumption

In line with earlier studies (e.g. Spiller and Nitzko, 2015; Dagevos and Voordouw, 2013) our findings support that a targeted policy and a focussed strategic approach will be most effective at encouraging meat substitution. Information campaigns are an example of consumer education instruments that according to our findings could be developed to increase consumers awareness and encourage substitution of meat (Dagevos and Voordouw,

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

2013; Sutton and Dibb, 2013). As consumer preferences for meat substitute products were low for consumers in all segments (except the vegetarians), but high for the product characteristics of meat substitutes (such as low carbon footprint and low fat content) we emphasise the importance of educational campaigns as a first step for policy makers, initially targeting 'healthy eaters' and 'green' consumers. Additionally, according to Dagevos and Voordouw (2013) information campaigns aiming to create meat reduction tendencies and increase awareness on the unsustainability of meat can be an important first step of policy makers to encourage consumers to accept future (possibly more invasive) interventions.

Product labelling is another example of information provision that its effectiveness has been argued in the past (e.g. Van Loo et al., 2014; Gadema and Oglethorpe, 2011) and is supported by the findings of this study. The importance of clear and consistent nutritional labels (such as traffic light systems), carbon footprint labels and country of origin labels are just a few examples of the topics discussed in academic literature (Koistinen et al., 2013) and corroborated in the current research, that policy makers can take into consideration to encourage meat substitution. In the current study, although both 'healthy eaters' and 'organic' consumers segments have shown very low utilities for meat substitutes, food marketers and policy makers can take advantage of their high interest for low fat content by supporting the introduction of engaging nutritional labels. Although in the UK front-of-pack nutritional information (e.g. traffic-light labels) has to-date been voluntary and self-regulated (Department of Health, 2013), most food retailers and many major food manufacturers have signed up (EUFIC, 2015). As efforts to promote healthy food choices are rising higher on the policy agenda, front of pack labelling can be effective not only in helping consumers make healthier choices (Feunekes et al., 2008; Van Kleef and Dagevos, 2015) but also in encouraging food manufacturers to develop healthier food products (Rayner et al., 2001). Furthermore, new opportunities for product differentiation could be created by meat substitute producers that could increase consumer awareness and stimulate demand for these products (Golan and Unnevehr, 2008).

Besides traffic light labels, a public labelling authority can improve consumer trust and the reputation of other labelling schemes, such as organic labels, origin labels and carbon labels to inform and engage consumers of other segments as well as encourage the production of more organic and environmentally friendly meat substitutes. For example 'green' consumers have the most positive view on the environmental impact of their food consumption and are less influenced by the type of mince or the price of their meat than consumers in other segments. In line with the findings of Van Loo et al. (2014), our results suggest that providing additional point of purchase information (such as carbon and origin labels) could be an effective pathway to meat substitution for environmentally conscious consumers, as plant-based meat substitutes generally have a lower carbon footprint. Introduction of transparent and comprehensible labelling systems and educating consumers in regards to the meaning of different sustainability labels can possibly pave the way for public acceptance of future regulations and policies in the area of food and greenhouse gas emissions (Gadema and Oglethorpe, 2011; Horne, 2009).

Nevertheless, provision of information should be accurate and balanced to enable consumers to make well-informed food purchases, as excessive amount of information may lead to consumer confusion and could be deceptively used as a self-promotion strategy for food industries (Nestle and Ludwig, 2010). The fact that the traffic-light labelling system has been developed by the Food Standards Agency, a non-commercial labelling authority, is very important to take into account, as earlier research showed that public sources in general have a higher credibility compared to commercial sources (Pieniak et al., 2010). Therefore, taken into consideration the findings of the current study, policy makers should also consider the development and consistent implementation of trustworthy and comprehensible food labels, focusing on carbon footprint, country of origin and production method.

Regarding the largest segment in the market, for 'price conscious' consumers, financial incentives may be required to raise the cost of potentially harmful levels of meat consumption. Changing the relative price of meat through taxes or reducing meat production support via subsidies could potentially be effective in reducing this segment's high levels of meat consumption (Thunström and Nordström, 2013; Nordgren, 2012). However the effectiveness of taxation to change consumption is controversial. As the 'price conscious' segment consisted mainly of low income consumers who have demonstrated higher preferences for low priced products, subsidising the production of meat substitute products, regulating price promotion of meat products and encouraging substitution of meat with personal subsidies (such as food stamps for low-income individuals for use on meat substitutes) could be a more holistic approach to meat reduction (Dagevos and Voordouw, 2013).

Members of the 'taste driven' segment are mainly meat eaters and they are the least likely to actively utilise health and production related information when purchasing meat. Raising their interest in meat substitutes by emphasising the advantages of reducing meat consumption for human health and the environment could be very challenging for policy makers and marketers. De Bakker and Dagevos (2012) suggest that a sustainability-by-stealth strategy can contribute to the efforts towards more sustainable consumption for consumers who are generally unconcerned with issues about food sustainability but will accept changes in their consumption, particularly if they are not very noticeable. The development of meat substitutes similar in use and aesthetic characteristics to meat, such as Quorn (Hoek et al., 2013; Elzerman et al., 2013), supported by campaigns highlighting the hedonic values and pleasure from eating such food, may have a better chance of having an impact among this consumer segment than labelling and educational campaigns. Additionally meat substitution by hybrid meat substitutes (i.e. a combination of meat and meat free products), could be used as a sustainability-by-stealth strategy to make meat reduction gradually more accessible for these consumers. By encouraging the production and promotion of meat substitutes and hybrid products, policy makers may assist consumers in this segment deal with food neophobia. Furthermore, the lower perceived health and quality image of meat substitute products could be overcome and small, incremental changes to taste driven consumer's choices delivered. While this strategy may be effective in drawing the attention and acceptability of 'taste driven' consumers', emphasising only the aesthetic similarity of meat substitutes to meat, may lead to criticism that the public is being misled, which could have an impact on effectiveness (de Bakker and Dagevos, 2012).

Finally, as food purchasing is most commonly habitual and heavily influenced by the conditions of the purchasing environment, choice architecture can be used to encourage 'taste driven' consumers towards meat substitution through more strategic product placement in food stores (Thorndike et al., 2014). For example encouraging a more visible product placement of meat substitutes in food stores or in canteens may lead to increased awareness and product trial that could address the issue of food neophobia.

The fact that the aforementioned strategies are distinct from each other does not imply that they are mutually exclusive nor that

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

there is one single 'panacea' that will lead to successful moderation of meat consumption (de Bakker and Dagevos, 2012; Nederkoorn et al., 2011; Tiffin and Arnoult, 2011). Therefore, it is important to find combinations of policies and marketing strategies in favour of improving sustainable food consumption. For example, choice architecture could be used in addition to food labels as part of a broader group of policies to encourage people to reduce meat consumption. Changing the social environment of consumption by placing meat substitutes in prominent positions in food stores, and increasing consumer understanding and trust in food labelling systems (e.g. carbon labels and method of production) may prove to be an effective meat reduction approach for policy makers.

10. Conclusion

One of the most effective approaches to decreasing meat consumption may be a partial replacement of meat by plant-based meat substitutes, as consumers may be more willing to accept a substitution between food products in their diets than to change their consumption or meal patterns (Schösler et al., 2012; Dagevos and Voordouw, 2013; de Bakker and Dagevos, 2012). However, despite the increasing media attention, policy reports and a growing body of academic literature highlighting the importance of reducing meat consumption, research that takes a consumer behaviour perspective has been limited and little is known about consumers' preferences for meat substitutes. In an attempt to address these gaps in the literature we have identified the role that specific attributes of meat and meat substitutes play in influencing consumer choices and identified segments of consumers based on their preferences. Our results have implications for the general public, policy makers, practitioners and producers of meat and meat substitutes.

Our findings indicate that although consumer preferences for meat substitutes are currently very low, there are several opportunities to encourage a decrease in meat-based diets through meat substitution. In line with previous studies (e.g. Spiller and Nitzko, 2015; Dagevos and Voordouw, 2013; Van Kleef and Dagevos, 2015; de Bakker and Dagevos, 2012; Nordgren, 2012), we have identified a number of strategies for promoting meat reduction through substitution. Corroborating findings of other authors (e.g. Geeroms et al., 2008), our results suggest that meat substitution policies and strategies should focus on specific consumer segments instead of targeting the average consumer, as the preferences of consumers differ within the different segments. The identification of six distinct segments has revealed the basic characteristics of these consumers which are relevant to future food policy. Segment specific policy interventions include the development of educational campaigns and food labelling regulations highlighting the: (1) health and nutrition benefits ('healthy' consumers); (2) environmental and carbon footprint benefits ('green' consumers) and (3) method of production and animal welfare benefits ('organic' consumers) of meat substitutes. Decreasing the relative price of meat free substitutes (by subsidising the production or consumption of these products) would encourage 'price conscious' consumers to substitute meat with meat free products. Finally, a sustainability-by-stealth campaign supporting the development and use of hybrid or meat free substitutes is the recommended approach for consumers in the 'taste driven' segment. This strategy would also help consumers in other segments overcome the generally low consumer preferences for meat substitute products compared to other types of mince.

The recommended strategies aim not only to reduce meat consumption to sustainable levels through meat substitution, but also to achieve long term changes in consumer culture towards meat consumption. Greater knowledge on the preferences of these segments will help the development of programs and policies that are tailored to fit the needs of specific target groups and will encourage substitution of meat with healthier, more sustainable products and in the long term a change towards more sustainable diets (Van Loo et al., 2014).

It is important to recognize some of the limitations of our study. In real life, food purchasing is influenced by a number of factors not considered in our study, including; advertising, promotional efforts and policy interventions which may also influence consumers' choices for meat and meat substitutes. Additionally, consumer preferences for meat substitute products may be influenced by product familiarity, which although we considered to be outside the scope of the current study, it is an additional variable that future research in meat substitution could explore. Although this study provides a stepping-stone towards better understanding of consumers' decision making process, it would be interesting to investigate how a non–hypothetical (revealed choice) experiment could be used to avoid hypothetical bias and further corroborate the findings of this study. Furthermore, the limited number of members in some of our segments (such as 'vegetarians' or 'organic' consumers) did not allow a clear evaluation of preferences and orientations of these segments and therefore additional research could focus on these consumers and examine in more details their preferences. Finally we acknowledge the fact that the attributes chosen in this study are a combination of 'old' (more familiar) and 'new' (less familiar to the consumers) attributes and also could be presented in different ways. For example, although in our study we have distinguished mince products imported from EU and non EU countries, providing information regarding the specific country that the products are imported from, may have an impact on consumer preferences. Similarly, providing more detailed information regarding organic production in the relevant attribute description in our survey may have also influenced consumer preferences in the experiment. Future research could also examine the impact of different labelling systems (such as different carbon footprint or method of production labels) on consumer preferences using a similar DCE design. In addition, using a longitudinal study would identify how potential future interventions influence meat substitution and meat reduction over time. Finally, since the need to reduce high levels of meat consumption is a global issue, a larger study involving participants from different countries would allow inter-country comparisons that will enable the examination of the effectiveness of the particular interventions in different contexts and the differences in preferences to be measured.

Although the results of this study focused on meat substitution, we do not imply that increasing the consumption of meat substitutes is the only way to encourage more sustainable consumption patterns. Various other authors have highlighted the advantages and disadvantages of other approaches such as meatless days and less-but-better-meat strategies (de Boer et al., 2014). Our results only show that, despite their limited market share and low levels of overall consumer utility, meat substitutes can play an important role in the sustainability agenda and support the development and implementation of policy agendas. In this context, we feel that the current research has not only contributed to existing literature and knowledge on meat reduction policies and strategies but hopefully will also lead to further discussion on how to further encourage more sustainable diets.

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Appendix A. Choice task example

Suppose that you visit your supermarket for your food shopping. You are planning to cook a mince based dish for your family dinner. You are presented with the following options of mince that you can buy and use for your dinner. If these were your only options, which would you choose?
Choose by clicking one of the buttons below:

Appendix B. Level utilities per segment

Table 1A

Table 1A
Level utilities per segment (n = 247).

Attribute	Level	Price conscious (42.5%)	Green (17%)	Taste driven (14.6%)	Healthy (10.5%)	Organic (9.7%)	Vegetarian (5.7%)
Fat content (g per 70 g portion and% GDA)	2% (1.5 g)	1.291	0.646	2.237	2.891	10.834	3.672
		0.157***	*0.229****	*0.252****	*0.323****	*0.129****	*0.170****
	5% (3.5 g)	0.888	0.149	−0.280	2.198	1.261	3.025
		0.144***	*0.203*	*0.287*	*0.146****	*0.129****	*0.153****
	10% (7 g)	−0.418	0.219	0.902	0.103	−1.043	1.560
		0.096***	*0.217*	*0.297****	*0.246*	*0.184****	*0.229****
	15% (10 g)	−0.367	−0.134	0.849	−0.943	1.863	−2.515

(*continued on next page*)

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Table 1A (*continued*)

Attribute	Level	Price conscious (42.5%)	Green (17%)	Taste driven (14.6%)	Healthy (10.5%)	Organic (9.7%)	Vegetarian (5.7%)
		*0.112***	*0.250*	*0.215***	*0.145***	*0.145***	*0.182***
	25% (17 g)	−1.395	−0.880	−3.709	−4.249	−8.753	−5.743
		*0.134***	*0.225***	*0.182***	*0.174***	*0.218***	*0.186***
Carbon footprint (kg/500 g of product)	1 kg	0.773	1.722	1.428	0.388	4.534	1.263
		*0.140***	*0.300***	*0.139***	*0.287*	*0.168***	*0.158***
	3.5 kg	0.497	0.513	1.366	0.724	−1.128	1.135
		*0.167***	*0.253***	*0.174***	*0.335***	*0.258***	*0.237***
	6 kg	−0.210	−0.513	0.226	−0.109	1.686	−0.240
		0.181	*0.227***	*0.224*	*0.239*	*0.159***	*0.155*
	13 kg	−0.364	−0.673	−1.849	−0.753	−3.248	−0.596
		*0.194**	*0.299***	*0.201***	*0.416**	*0.220***	*0.184***
	20 kg	−0.696	−1.048	−1.171	−0.250	−1.844	−1.562
		*0.149***	*0.343***	*0.128***	*0.384*	*0.105***	*0.262***
Type of mince	Beef	2.462	1.084	6.071	1.302	9.927	−1.473
		*0.229***	*0.254***	*0.381***	*0.220***	*0.197***	*0.251***
	Turkey	−0.579	0.129	0.271	1.346	0.302	−2.325
		*0.132***	*0.208*	*0.217*	*0.399***	*0.114***	*0.188***
	Lamb	−0.009	−0.475	0.400	0.283	−2.238	−3.257
		0.118	*0.206***	*0.100***	*0.368*	*0.101***	*0.150***
	Pork	−0.199	−0.362	1.995	0.255	−2.504	−1.418
		*0.115***	*0.227*	*0.192***	*0.276*	*0.185***	*0.108***
	Meat Free	−1.674	−0.375	−8.736	−3.186	−5.486	8.473
		*0.256***	*0.310*	*0.279***	*0.430***	*0.297***	*0.232***
Brand	Quorn	0.187	−0.005	−4.151	1.811	−0.741	1.760
		0.161	*0.232*	*0.383***	*0.276***	*0.248***	*0.103***
	My Butcher	0.146	0.396	6.258	−0.827	1.504	−1.057
		0.161	*0.239*	*0.394***	*0.321***	*0.271***	*0.239***
	Super market own label	−0.333	−0.391	−2.108	−0.984	−0.763	−0.703
		*0.055***	*0.098***	*0.068***	*0.124***	*0.065***	*0.183***
Method of Production	Organic	−0.139	0.177	2.580	0.622	4.114	0.314
		0.074	*0.116*	*0.130***	*0.081***	*0.076***	*0.145**
	Not organic/GM free	0.094	−0.427	−2.140	−0.327	−0.539	−1.658
		*0.089**	*0.152***	*0.182***	*0.159**	*0.138***	*0.104***
	Conventional	0.045	0.251	−0.440	−0.294	−3.575	1.344
		0.101	*0.175*	*0.168***	*0.169**	*0.113***	*0.144***
Origin	Imported (EU country)	−0.139	−0.902	−1.305	−0.979	−0.535	−0.131
		0.172	*0.124***	*0.208***	*0.292***	*0.181***	*0.214*
	UK	0.394	0.733	2.859	2.264	0.335	1.053
		*0.106***	*0.207***	*0.103***	*0.119***	*0.170**	*0.189***
	Local	1.510	1.079	3.205	0.185	0.893	1.285
		*0.115***	*0.216***	*0.125***	*0.414*	*0.079***	*0.280***
	Imported (Non EU)	−1.764	−0.557	−4.759	−1.471	−0.693	−2.207
		*0.132***	*0.366*	*0.246***	*0.548***	*0.118***	*0.289***
Price (£/500 gr)	£2	1.767	0.447	4.137	−0.701	−1.037	0.338
		*0.220***	*0.230**	*0.190***	*0.455*	*0.327***	*0.344*
	£3	0.349	0.266	0.221	−0.080	3.814	0.961
		*0.161**	*0.153**	*0.179*	*0.149*	*0.190***	*0.200***
	£4	−0.875	−0.047	−1.307	0.933	−5.256	0.702
		*0.164***	*0.183*	*0.164***	*0.236***	*0.266***	*0.170***
	£5	−1.241	−0.666	−3.050	−0.153	2.479	−2.001
		*0.169***	*0.153***	*0.175***	*0.247*	*0.207***	*0.169***
	None	−0.201	0.845	−4.816	0.031	1.956	8.281
		0.127	*0.323***	*0.262***	*0.282*	*0.299***	*0.119**

Note: Standard errors in italics.
* Indicates significance at the 0.1 level.
** Indicate significance at the 0.05 level.
*** Indicate significance at the 0.01 level.

References

Aiking, H., de Boer, J., Vereijken, J., 2006. Sustainable Protein Production and ConsumptionPigs or Peas? Springer Science & Business Media.

Akdeniz, B., Calantone, R.J., Voorhees, C.M., 2013. Effectiveness of marketing cues on consumer perceptions of qualitythe moderating roles of brand reputation and third-party information. Psychol. Market. 30 (1), 76–89.

Baba, Y., Kallas, Z., Costa-Font, M., Gil, J.M., Realini, C.E., 2016. Impact of hedonic evaluation on consumers' preferences for beef attributes including its enrichment with n-3 and CLA fatty acids. Meat Sci. 111, 9–17.

Bajželj, B., Richards, K.S., Allwood, J.M., Smith, P., Dennis, J.S., Curmi, E., Gilligan, C.A., 2014. Importance of food-demand management for climate mitigation. Nat. Clim. Change 4 (10), 924–929.

BBC, 2015. Can eating Less Meat Help Reduce Climate Change (November, 24) http://www.bbc.co.uk/news/science-environment-34899066 (accessed 01.04.16).

BBC, 2014. Red Meat 'Linked to Breast Cancer'. News, BBC (June, 11). <http://www.bbc.co.uk/news/health-27777210> (accessed 17.01.15).

Bíró, A., 2015. Did the junk food tax make the Hungarians eat healthier? Food Policy 54, 107–115.

Bødker, M., Pisinger, C., Toft, U., Jørgensen, T., 2015. The rise and fall of the world's first fat tax. Health Policy 119 (6), 737–742.

Boxall, P.C., Adamowicz, W.L., 2002. Understanding heterogeneous preferences in random utility modelsa latent class approach. Environ. Resource Econ. 23 (4), 421–446.

Boztuğ, Y., Juhl, H.J., Elshiewy, O., Jensen, M.B., 2015. Consumer response to monochrome Guideline Daily Amount nutrition labels. Food Policy 53, 1–8.

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Carlsson, F., Frykblom, P., Lagerkvist, C.J., 2007. Consumer benefits of labels and bans on GM foods—choice experiments with Swedish consumers. Am. J. Agric. Econ. 89 (1), 152–161.

Childs, J.L., Thompson, J.L., Lillard, J.S., Berry, T.K., Drake, M., 2008. Consumer perception of whey and soy protein in meal replacement products. J. Sens. Stud. 23 (3), 320–339.

Coast, J., Al-Janabi, H., Sutton, E.J., Horrocks, S.A., Vosper, A.J., Swancutt, D.R., Flynn, T.N., 2012. Using qualitative methods for attribute development for discrete choice experimentsissues and recommendations. Health Econ. 21 (6), 730–741.

Dagevos, H., Voordouw, J., 2013. Sustainability and meat consumptionis reduction realistic. Sustain. Sci. Pract. Policy 9 (2), 60–69.

de Bakker, E., Dagevos, H., 2012. Reducing meat consumption in today's consumer societyquestioning the citizen-consumer gap. J. Agric. Environ. Ethics 25 (6), 877–894.

de Boer, J., Schösler, H., Aiking, H., 2014. "Meatless days" or "less but better"? Exploring strategies to adapt Western meat consumption to health and sustainability challenges. Appetite 76, 120–128.

de Jonge, J., van der Lans, I.A., van Trijp, H.C., 2015. Different shades of greycompromise products to encourage animal friendly consumption. Food Qual. Prefer. 45, 87–99.

de Jonge, J., van Trijp, H., 2014. Heterogeneity in consumer perceptions of the animal friendliness of broiler production systems. Food Policy 49, 174–185.

Defra, 2013a. Sustainable Consumption Report. Follow-up to the Green Food Project. Department for Environment, Food & Rural Affairs, London <www.gov.uk/government/publications/sustainable-consumption-report-follow-up-to-the-green-food-project> (accessed 28.10.13).

Defra, 2013b. Family Food 2012. Department for Environment, Food & Rural Affairs, London <https://www.gov.uk/government/collections/family-food-statistics> (accessed 29.05.2014).

Department of Health, 2013. Guide to Creating a Front of Pack (FoP) Nutrition Label for Pre-packed Products sold through Retail Outlets <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207588/FINAL_VERSION_OF_THE_2013_FOP_GUIDANCE_-_WEB.pdf> (accessed 30.09.14).

Department of Health, 2011. National Diet and Nutrition Surveyheadline results from years 1 and 2 (combined) of the Rolling Programme, 2008/9-2009/10 <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsStatistics/DH_128166> (accessed 30.05.14).

DeFrance, S.D., 2009. Zooarchaeology in complex societiesPolitical economy, status, and ideology. J. Archaeol. Res. 17, 105–168.

Draper, A.K., Adamson, A.J., Clegg, S., Malam, S., Rigg, M., Duncan, S., 2013. Front-of-pack nutrition labellingare multiple formats a problem for consumers? Euro. J. Public Heal. 23 (3), 517–521.

Drichoutis, A.C., Lazaridis, P., Nayga, R.M., 2005. Nutrition knowledge and consumer use of nutritional food labels. Euro. Rev. Agri. Econ. 32 (1), 93–118.

EBLEX, 2013. UK Yearbook 2012 – Cattle Available at: <www.eblex.org.uk/wp/wpEllipsis/02/m_uk_yearbook13_Cattle110713.pdf> (accessed 20.01.15).

Edjabou, L.D., Smed, S., 2013. The effect of using consumption taxes on foods to promote climate friendly diets–the case of Denmark. Food Policy 39, 84–96.

Elzerman, J.E., van Boekel, M.A., Luning, P.A., 2013. Exploring meat substitutesconsumer experiences and contextual factors. Brit. Food J. 115 (5), 700–710.

EUFIC, 2015. Global Update on Nutrition Labelling <http://www.eufic.org/upl/1/default/doc/GlobalUpdateExecSumJan2015.pdf> (accessed 01.04.2015).

European Commission, 2013. Commission implementing regulation (EU) No 1337/2013 of 13 December 2013 laying down rules for the application of Regulation (EU) No 1169/2011 of the European Parliament and of the Council as regards the indication of the country of origin or place of provenance for fresh, chilled and frozen meat of swine, sheep, goats and poultry. Off. J. Euro. Union L335 (12), 19–22.

European Commission, 2007. Council Regulation (EC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91. Off. J. Euro. Union L189 (07), 1–122.

Feunekes, G.I., Gortemaker, I.A., Willems, A.A., Lion, R., Van Den Kommer, M., 2008. Front-of-pack nutrition labellingtesting effectiveness of different nutrition labelling formats front-of-pack in four European countries. Appetite 50 (1), 57–70.

Finnigan, T., Lemon, M., Allan, B., Paton, I., 2010. Mycoprotein, life cycle analysis and the food 2030 challenge. Aspects Appl. Biol. 102, 81–90.

Font-i-Furnols, M., Tous, N., Esteve-Garcia, E., Gispert, M., 2012. Do all the consumers accept marbling in the same way? The relationship between eating and visual acceptability of pork with different intramuscular fat content. Meat Sci. 91 (4), 448–453.

Food Standards Agency, 2013a. Guide to Creating a Front of Pack (FoP) Nutrition Label for Pre-packed Products Sold through Retail Outlets <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300886/2902158_FoP_Nutrition_2014.pdf> (accessed 10.01.16).

Food Standards Agency, 2013b. Short ConsultationEU Harmonisation of 'GM-free' Labelling <http://www.food.gov.uk/multimedia/pdfs/gm-labelling-short-consultation.pdf> (accessed 10.01.16).

Food Standards Agency, 2009. Public Attitudes to Food Issues <http://www.food.gov.uk/multimedia/pdfs/publicattitudestofood.pdf> (accessed 03.03.15).

Foresight, 2011. The Future of Food and Farming, Final Project Report. Government Office for Science, London.

Gadema, Z., Oglethorpe, D., 2011. The use and usefulness of carbon labelling fooda policy perspective from a survey of UK supermarket shoppers. Food Policy 36 (6), 815–822.

Geeroms, N., Verbeke, W., Van Kenhove, P., 2008. Health advertising to promote fruit and vegetable intakeapplication of health-related motive segmentation. Food Qual. Prefer. 19 (5), 481–497.

German Council for Sustainable Development, 2013. The Sustainable Shopping BasketA Guide to Better Shopping. German Council for Sustainable Development, Berlin.

Golan, E., Unnevehr, L., 2008. Food product composition, consumer health, and public policyintroduction and overview of special section. Food Policy 33 (6), 465–469.

Grebitus, C., Jensen, H.H., Roosen, J., 2013. US and German consumer preferences for ground beef packaged under a modified atmosphere–different regulations, different behaviour? Food Policy 40, 109–118.

Green, C., Gerard, K., 2009. Exploring the social value of health-care interventionsa stated preference discrete choice experiment. Health Econ. 18 (8), 951–976.

Grunert, K.G., Fernández-Celemín, L., Wills, J.M., genannt Bonsmann, S.S., Nureeva, L., 2010. Use and understanding of nutrition information on food labels in six European countries. J. Public Heal. 18 (3), 261–277.

Grunert, K.G., Hieke, S., Wills, J., 2014. Sustainability labels on food productsconsumer motivation, understanding and use. Food Policy 44, 177–189.

Hallström, E., Röös, E., Börjesson, P., 2014. Sustainable meat consumptiona quantitative analysis of nutritional intake, greenhouse gas emissions and land use from a Swedish perspective. Food Policy 47, 81–90.

Hamerschlag, K., Venkat, K., 2011. Meat Eater's Guide to Climate Change and Health–Life-Cycle AssessmentsMethodology and Results. Environmental Working Group, Washington, DC.

Health Council of the Netherlands, 2011. Guidelines for a Healthy DietThe Ecological Perspective. Gezondheidsraad, The Hague, Netherlands.

Hoek, A.C., Elzerman, J.E., Hageman, R., Kok, F.J., Luning, P.A., de Graaf, C., 2013. Are meat substitutes liked better over time? A repeated in-home use test with meat substitutes or meat in meals. Food Qual. Prefer. 28 (1), 253–263.

Hoek, A.C., Luning, P.A., Weijzen, P., Engels, W., Kok, F.J., de Graaf, C., 2011. Replacement of meat by meat substitutes. A survey on person- and product-related factors in consumer acceptance. Appetite 56 (3), 662–673.

Hoen, A., Koetse, M.J., 2014. A choice experiment on alternative fuel vehicle preferences of private car owners in the Netherlands. Transport. Res. Part A Policy Pract. 61, 199–215.

Horne, R.E., 2009. Limits to labelsthe role of eco-labels in the assessment of product sustainability and routes to sustainable consumption. Int. J. Consum. Stud. 33 (2), 175–182.

Hoyos, D., 2010. The state of the art of environmental valuation with discrete choice experiments. Ecol. Econ. 69 (8), 1595–1603.

Hu, W., Hünnemeyer, A., Veeman, M., Adamowicz, W., Srivastava, L., 2004. Trading off health, environmental and genetic modification attributes in food. Euro. Rev. Agri. Econ. 31 (3), 389–408.

IARC, 2015. IARC Monographs Evaluate the Consumption of Red Meat and Processed Meat <https://www.iarc.fr/en/media-centre/pr/2015/pdfs/pr240_E.pdf> (accessed on 14.01.16).

Jaeger, S.R., Hedderley, D., MacFie, H.J., 2001. Methodological issues in conjoint analysisa case study. Eur. J. Mark. 35 (11/12), 1217–1239.

Jensen, J.D., Smed, S., 2013. The Danish tax on saturated fat–short run effects on consumption, substitution patterns and consumer prices of fats. Food Policy 42, 18–31.

Johnson, F.R., Lancsar, E., Marshall, D., Kilambi, V., Mühlbacher, A., Regier, D.A., Bridges, J.F., et al., 2013. Constructing experimental designs for discrete-choice experimentsreport of the ISPOR conjoint analysis experimental design good research practices task force. Value Health 16 (1), 3–13.

Keynote, 2013. Meat & Meat Products Market Assessment 2013. Key Note Ltd., Richmond upon Thames.

Koistinen, L., Pouta, E., Heikkilä, J., Forsman-Hugg, S., Kotro, J., Mäkelä, J., Niva, M., 2013. The impact of fat content, production methods and carbon footprint information on consumer preferences for minced meat. Food Qual. Prefer. 29 (2), 126–136.

Krystallis, A., Grunert, K.G., de Barcellos, M.D., Perrea, T., Verbeke, W., 2012. Consumer attitudes towards sustainability aspects of food productioninsights from three continents. J. Market. Manage. 28 (3–4), 334–372.

Laestadius, L.I., Neff, R.A., Barry, C.L., Frattaroli, S., 2014. "We don't tell people what to do"an examination of the factors influencing NGO decisions to campaign for reduced meat consumption in light of climate change. Glob. Environ. Change 29, 32–40.

Lancaster, K.J., 1966. A new approach to consumer theory. J. Polit. Econ., 132–157.

Latvala, T., Niva, M., Mäkelä, J., Pouta, E., Heikkilä, J., Kotro, J., Forsman-Hugg, S., 2012. Diversifying meat consumption patternsConsumers' self-reported past behaviour and intentions for change. Meat Sci. 92 (1), 71–77.

Loureiro, M.L., Umberger, W.J., 2007. A choice experiment model for beefwhat US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. Food Policy 32 (4), 496–514.

Louviere, J.J., Hensher, D.A., Swait, J.D., 2000. Stated Choice MethodsAnalysis and Application. Cambridge University Press, New York.

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002

Lüthi, S., Prässler, T., 2011. Analyzing policy support instruments and regulatory risk factors for wind energy deployment—a developers' perspective. Energy Policy 39 (9), 4876–4892.
McEachern, M.G., Schröder, M.J., 2002. The role of livestock production ethics in consumer values towards meat. J. Agric. Environ. Ethics 15 (2), 221–237.
McFadden, 1973. Conditional logit analysis of qualitative choice behaviour. In: Zarembka, P. (Ed.), Frontiers in Econometrics. Academic Press, New York, pp. 105–142. 1974.
McFadden, D., 2001. Economic choices. Am. Econ. Rev., 351–378
MINTEL, 2015. Red Meat-UK. Mintel International Group Limited.
MINTEL, 2014. Meat-Free and Free-From Foods-UK. Mintel International Group Limited.
MINTEL, 2013a. Meat-Free and Free-From Foods-UK. Mintel International Group Limited.
MINTEL, 2013b. Red Meat-UK. Mintel International Group Limited.
Mintel, 2011. Food Retailers-UK. Mintel International Group Limited.
Mueller, S., Lockshin, L., Louviere, J.J., 2010a. What you see may not be what you getAsking consumers what matters may not reflect what they choose. Market. Lett. 21 (4), 335–350.
Mueller, S., Osidacz, P., Francis, I.L., Lockshin, L., 2010b. Combining discrete choice and informed sensory testing in a two-stage processcan it predict wine market share? Food Qual. Prefer. 21 (7), 741–754.
Nederkoorn, C., Havermans, R.C., Giesen, J.C., Jansen, A., 2011. High tax on high energy dense foods and its effects on the purchase of calories in a supermarket. An experiment. Appetite 56 (3), 760–765.
Nestle, M., Ludwig, D.S., 2010. Front-of-package food labelspublic health or propaganda? JAMA 303 (8), 771–772.
Nguyen, T.L.T., Hermansen, J.E., Mogensen, L., 2010. Environmental consequences of different beef production systems in the EU. J. Cleaner Prod. 18 (8), 756–766.
Nijdam, D., Rood, T., Westhoek, H., 2012. The price of proteinreview of land use and carbon footprints from life cycle assessments of animal food products and their substitutes. Food Policy 37 (6), 760–770.
Nocella, G., Boecker, A., Hubbard, L., Scarpa, R., 2012. Eliciting consumer preferences for certified animal-friendly foodscan elements of the theory of planned behavior improve choice experiment analysis? Psychol. Market. 29 (11), 850–868.
Nordgren, A., 2012. A climate tax on meat? In: Climate Change and Sustainable Development. Wageningen Academic Publishers, pp. 109–114.
Office for National Statistics, 2013. 2011 Census – Population and Household Estimates for England and Wales <http://www.ons.gov.uk/ons/dcp171778_270487.pdf> (accessed 03.03.14).
Olmedilla-Alonso, B., Jiménez-Colmenero, F., Sánchez-Muniz, F.J., 2013. Development and assessment of healthy properties of meat and meat products designed as functional foods. Meat Sci. 95 (4), 919–930.
Piazza, J., Ruby, M.B., Loughnan, S., Luong, M., Kulik, J., Watkins, H.M., Seigerman, M., 2015. Rationalizing meat consumption. The 4Ns. Appetite 91, 114–128.
Pieniak, Z., Verbeke, W., Olsen, S.O., Hansen, K.B., Brunsø, K., 2010. Health-related attitudes as a basis for segmenting European fish consumers. Food Policy 35 (5), 448–455.
Radnitz, C., Beezhold, B., DiMatteo, J., 2015. Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. Appetite 90, 31–36.
Rayner, M., Boaz, A., Higginson, C., 2001. Consumer use of health-related endorsements on food labels in the United Kingdom and Australia. J. Nutrition Edu. 33 (1), 24–30.
Realini, C.E., Font i Furnols, M., Sañudo, C., Montossi, F., Oliver, M.A., Guerrero, L., 2013. Spanish, French and British consumers' acceptability of Uruguayan beef, and consumers' beef choice associated with country of origin, finishing diet and meat price. Meat Sci. 95 (1), 14–21.
Reed, Z., McIlveen-Farley, H., Strugnell, C., 2003. Factors affecting consumer acceptance of chilled ready meals on the island of Ireland. Int. J. Consum. Stud. 27 (1), 2–10.
Ripoll-Bosch, R., De Boer, I.J.M., Bernués, A., Vellinga, T.V., 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamba comparison of three contrasting Mediterranean systems. Agric. Syst. 116, 60–68.
Röös, E., 2012. Mat-Klimat-Listamn Version 1.0 (The Food-Climate-List Version 1.0) Report 2012040. Department of Energy and Technology, Swedish University of Agricultural Sciences, Uppsala.
Röös, E., Ekelund, L., Tjärnemo, H., 2014. Communicating the environmental impact of meat productionchallenges in the development of a Swedish meat guide. J. Cleaner Prod. 73, 154–164.
Röös, E., Sundberg, C., Tidåker, P., Strid, I., Hansson, P.A., 2013. Can carbon footprint serve as an indicator of the environmental impact of meat production? Ecol. Ind. 24, 573–581.
Röös, E., Tjärnemo, H., 2011. Challenges of carbon labelling of food productsa consumer research perspective. Brit. Food J. 113 (8), 982–996.
Ruto, E., Garrod, G., Scarpa, R., 2008. Valuing animal genetic resourcesa choice modeling application to indigenous cattle in Kenya. Agri. Econ. 38 (1), 89–98.
Säll, S., Gren, M., 2015. Effects of an environmental tax on meat and dairy consumption in Sweden. Food Policy 55, 41–53.
Schmeer, K.K., 2005. Married women's resource position and household food expenditures in Cebu, Philippines. J. Marriage Family 67 (2), 399–409.
Schösler, H., de Boer, J., Boersema, J.J., 2014. Fostering more sustainable food choices: Can Self-Determination Theory help? Food Qual. Prefer. 35, 59–69.
Schösler, H., De Boer, J., Boersema, J.J., 2012. Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution. Appetite 58 (1), 39–47.
Silayoi, P., Speece, M., 2007. The importance of packaging attributesa conjoint analysis approach. Eur. J. Mark. 41 (11/12), 1495–1517.
Sofi, F., Abbate, R., Gensini, G.F., Casini, A., 2010. Accruing evidence on benefits of adherence to the Mediterranean diet on healthan updated systematic review and meta-analysis. Am. J. Clin. Nutrition 92 (5), 1189–1196.
Spiller, A., Nitzko, S., 2015. 12. Peak meatthe role of meat in sustainable consumption. InHandbook of Research on Sustainable Consumption, 192.
Sutton, C., Dibb, S., 2013. Prime CutsValuing the Meat We Eat. WWF-UK (World Wide Fund For Nature) and the Food Ethics Council, Surrey, UK.
Tabi, A., Hille, S.L., Wüstenhagen, R., 2014. What makes people seal the green power deal?—Customer segmentation based on choice experiment in Germany. Ecol. Econ. 107, 206–215.
Thøgersen, J., Zhou, Y., 2012. Chinese consumers' adoption of a 'green' innovation–the case of organic food. J. Market. Manage. 28 (3–4), 313–333.
Thorndike, A.N., Riis, J., Sonnenberg, L.M., Levy, D.E., 2014. Traffic-light labels and choice architecture: promoting healthy food choices. Am. J. Prev. Med. 46 (2), 143–149.
Thunström, L., Nordström, J., 2013. The impact of meal attributes and nudging on healthy meal consumption-evidence from a lunch restaurant field experiment. Modern Econ. 4 (10A), 1–8.
Tiffin, R., Arnoult, M., 2011. The public health impacts of a fat tax. Eur. J. Clin. Nutr. 65 (4), 427–433.
Troy, D.J., Kerry, J.P., 2010. Consumer perception and the role of science in the meat industry. Meat Sci. 86 (1), 214–226.
Tubiello, F.N., Salvatore, M., Cóndor Golec, R.D., Ferrara, A., Rossi, S., Biancalani, R., Flammin, A., et al. (2014). Agriculture, forestry and other land use emissions by sources and removals by sinks1990–2011 analysis. FAO Statistics Division. Working Paper Series ESS/14-02. <http://www.fao.org/docrep/019/i3671e/i3671e.pdf> (accessed 24.10.14).
Tucker, C.A., 2014. The significance of sensory appeal for reduced meat consumption. Appetite 81, 168–179.
Tukker, A., Emmert, S., Charter, M., Vezzoli, C., Sto, E., Munch Andersen, M., Lahlou, S., et al., 2008. Fostering change to sustainable consumption and productionan evidence based view. J. Cleaner Prod. 16 (11), 1218–1225.
U.S. Department of Agriculture, 2015. Scientific report of the 2015 Dietary Guidelines Advisory Committee. <http://www.health.gov/dietaryguidelines/2015-scientific-report/PDFs/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf> (accessed 13.03.15).
van Dooren, C., Marinussen, M., Blonk, H., Aiking, H., Vellinga, P., 2014. Exploring dietary guidelines based on ecological and nutritional valuesa comparison of six dietary patterns. Food Policy 44, 36–46.
Van Kleef, E., Dagevos, H., 2015. The growing role of front-of-pack nutrition profile labelinga consumer perspective on key issues and controversies. Crit. Rev. Food Sci. Nutr. 55 (3), 291–303.
Van Loo, E.J., Caputo, V., Nayga Jr., R.M., Meullenet, J.F., Ricke, S.C., 2011. Consumers' willingness to pay for organic chicken breastevidence from choice experiment. Food Qual. Prefer. 22 (7), 603–613.
Van Loo, E.J., Caputo, V., Nayga, R.M., Verbeke, W., 2014. Consumers' valuation of sustainability labels on meat. Food Policy 49, 137–150.
Van Wezemael, L., Caputo, V., Nayga, R.M., Chryssochoidis, G., Verbeke, W., 2014. European consumer preferences for beef with nutrition and health claimsa multi-country investigation using discrete choice experiments. Food Policy 44, 167–176.
Vanhonacker, F., Van Loo, E.J., Gellynck, X., Verbeke, W., 2013. Flemish consumer attitudes towards more sustainable food choices. Appetite 62, 7–16.
Verain, M., Dagevos, H., Antonides, G., 2015. Flexitarianism a range of sustainable food styles. In: Reisch, L.A., Thøgersen, J. (Eds.), Handbook of Research on Sustainable Consumption. Edward Elgar Publishing, pp. 209–223.
Verbeke, W., Pérez-Cueto, F.J., Barcellos, M.D.D., Krystallis, A., Grunert, K.G., 2010. European citizen and consumer attitudes and preferences regarding beef and pork. Meat Sci. 84 (2), 284–292.
Vergnaud, A.C., Norat, T., Romaguera, D., Mouw, T., May, A.M., Travier, N., Couto, E., 2010. Meat consumption and prospective weight change in participants of the EPIC-PANACEA study. Am. J. Clin. Nutrition 92 (2), 398–407.
Westhoek, H., Lesschen, J.P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., Oenema, O., 2014. Food choices, health and environmenteffects of cutting Europe's meat and dairy intake. Glob. Environ. Change 26, 196–205.
Westland, S., Crawley, H., 2012. Healthy and Sustainable Diets in the Early Years. First Steps Nutrition Trust.
Wirsenius, S., Azar, C., Berndes, G., 2010. How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? Agric. Syst. 103 (9), 621–638.
Yadavalli, A., Jones, K., 2014. Does media influence consumer demand? The case of lean finely textured beef in the United States. Food Policy 49, 219–227.

Please cite this article in press as: Apostolidis, C., McLeay, F. Should we stop meating like this? Reducing meat consumption through substitution. Food Policy (2016), http://dx.doi.org/10.1016/j.foodpol.2016.11.002